Broadcast Signal Lab

Comments in Response to the
Further Notice of Proposed Rulemaking and Notice of Inquiry

In the Matter of Digital Audio Broadcasting Systems and their Impact on the Terrestrial Radio Broadcast Service

MM Docket No. 99-325
Adopted April 15, 2004

June 16, 2004

Broadcast Signal Lab is pleased to provide these comments. Broadcast Signal Lab principal David P. Maxson has been an active participant in the proceedings of the National Radio Systems Committee Digital Audio Broadcasting Subcommittee since 1998 and has presented numerous technical papers on the subject of In Band On Channel digital radio broadcasting. Broadcast Signal Lab provides radio and television broadcasters with essential signal analysis and measurement services and has done so since 1982. We are avid supporters of the in-band digital radio service and have some opinions about the manner in which it should be adopted to achieve the most beneficial results to the public.

The format of this commentary follows that of the Further Notice, including reference to Further Notice paragraph numbers.

Sec III, B. Conversion Policy

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Par.s 15 & 17:

The Commission seeks comment on the pace of analog to hybrid conversion and the possibility of all-digital radio in the future. The beauty of the IBOC approach is that there is no spectrum to return at the end of a transition period, as there is in the DTV arena. Adoption can take as long as it needs to, enabling it to remain transparent to the consumer.

If adoption of IBOC by the consumer becomes slow or stalled at some point in the future, the consequence is primarily that other digital media may be developing a market advantage over local digital radio broadcasting. Perhaps the best bellwether of a failing IBOC adoption in need of FCC intervention is in a measure of the industry's confidence in the technology—the number of stations transmitting hybrid IBOC signals. The Commission could annually inventory the number of stations transmitting IBOC signals, say, 90% or more of their analog broadcasting time. This figure should rise steadily for several years and then plateau. If industry confidence wanes, it will be apparent in an erosion of the transmission of hybrid IBOC systems. Industry confidence will be a valuable indicator of the interest the public has in IBOC broadcasting and ultimately the probable success of the technology.

Par 16:

Comment is sought on changes in rules that are likely to encourage radio stations to convert to IBOC. There was a long slow climb for RBDS adoption because the value proposition to the broadcaster and the public was not strong. The classic "chicken-and-egg" problem stymied broadcasters and receiver manufacturers. As text displays in receivers become more commonplace and consumers become used to getting supplemental content information on other media, consumer expectations for the information functions of RBDS grows.

IBOC technology, on the other hand, offers a significant value proposition to the consumer. A renewed value in AM broadcasting will arise as consumers find the AM band again through IBOC. AM broadcasters will be able to be more competitive in providing the public with more real choice in programming. FM reception will become more reliable also, and there will be fewer urges to change from radio to CD as a result of faulty reception. If the subjective tests of listener perception of broadcast-processed IBOC audio are a guide, the listener fatigue factor of analog broadcasting may be diminished on the digital side.

Overall, then, it can be expected that the improved reception, quality, and features of IBOC will be the drivers for broadcasters, receiver manufacturers, and consumers to get on the bandwagon. The biggest obstacle to a smaller broadcaster is the cost of the system. Other than offering spectrum fee rebates to smaller broadcasters who adopt IBOC by a deadline, the best incentive that the FCC could provide is in its regulatory structure of the IBOC medium. IBiquity Corporation has done a fantastic job developing what many predicted would be impossible and it deserves recognition and recompense for its efforts. At the same time, the company holds a central position in the IBOC marketplace. With such dominance of the technology comes the potential for too much control in the hands of one enterprise. As the regulatory authority, the FCC should be certain that all standards and policies encourage competition in all levels of the IBOC marketplace. Chipsets, firmware, protocols, system control software, data service definitions, receiver features and functions, and much more must be placed on a level playing field so that real competition and innovation can occur. Innovators should not be forced to get the permission of the dominant competitor to develop new ideas. Licensure of the core technologies should be at arms length from the activities that develop features that utilize the technology. Below we discuss the cases of data transmission and supplemental audio services that exemplify these issues.

Paragraph 16 also comments on the "spectrum efficiencies and related new service opportunities inherent in the IBOC system." A footnote is appended referring to all-digital coverage and how some think it will be greater than analog coverage. Presumably

this is one of the "spectrum efficiencies" to which the Further Notice refers, but hopefully not the only one.

As we have shown in our study of FM radio receivers submitted in the LPFM proceedings, the range of performance of analog radios is quite wide. Some are more sensitive and selective than others; some hide multipath interference better than others. This is simply the result of receiver manufacturers balancing price points against various performance characteristics. No doubt, the radio manufacturing industry will do the same in the digital world. The major difference in the digital world is that the performance of a given receiver will be even more dependent on its design and less dependent on "bad reception." The digital system is designed to overcome the vagaries of the RF channel while the analog system is entirely subordinate to them. Different tradeoffs will be made in the digital manufacturing world than in the analog, which is likely to result in IBOC radios that will work better or more poorly than other IBOC radios at a given distance or under a given set of interference conditions.

Certainly with the advent of all-digital transmission, the removal of analog energy in the broadcast bands will make it easier to receive digital signals and easier to make even more inexpensive digital radios. Coverage radius is but one factor in the complex equation of receiver design, cost, and station assignments.

There are two characteristics that are much more appealing about the spectrum efficiencies of the IBOC system—improved reception means improved choice, and digital features mean continued relevance for radio in the 21st century. If one tunes across the radio band on a given analog radio today, a certain number of stations come in very well, some well enough, some tolerably well, some not so well, and some not at all. The benefit of digital broadcasting is that all the stations that presently come in well enough, and tolerably, and many stations that come in not so well in analog, will come in equally well at a given location. Digital broadcasting will increase consumer choice and programming competition when listeners have more stations to receive with good quality.

This occurs entirely by improving performance within stations' protected coverage areas and without changing station assignments or increasing coverage contours..

The digital features being offered on RBDS today are equivalent in some ways to the text information being transmitted on the subscription satellite audio channels. In a multimedia world today people are becoming accustomed to more information, new features and interactivity from their media services. Radio broadcasting must have the unfettered ability to innovate new free and for-fee services that tie into other systems (navigation, traffic, weather, automobile, computer, etc). If the role of a sponsor of a radio broadcast is to reach the listener with products, services, and information that are valuable to him/her, then it is paramount that the broadcaster be able to experiment with ways to enhance and extend the listener experience without artificial regulatory barriers. The public and the sponsor benefit when the broadcaster brings them together with interactive services, sometimes for a fee, sometimes for free— at the cost of exposure to or participation in a sponsored activity. With innovation, the local medium of radio broadcasting remains technologically relevant to the very citizens it is intended to serve.

Spectrum efficiencies, then, are only efficient if they are allowed to evolve on an open standards platform with a minimum of regulatory control. Just as it will not be healthy to have the controlling hand of one dominant player in the development of new services and features, it will not be healthy to have undue regulation of the use of the IBOC spectrum. The role of the Commission is best played in setting the tone for innovation and competition in the digital radio marketplace and in permitting industry cooperation through open standards to guide the development of features that serve the public demand.

IV Rule Changes and Amendments

A. Service Rules

Par. 19:

Should broadcasters provide a minimum amount of "high definition audio?" It is in the broadcasters' interest to transmit a program of sufficient quality to maintain listenership. The main analog audio channel blends to digital shortly after tuning in on a digital radio and back to analog where the digital signal becomes unreliable. The broadcaster will have to choose how much bandwidth to give to the main program audio to satisfy the digital listener who will hear it in juxtaposition with the analog. Voice only programming will place one set of demands on bandwidth while open unprocessed classical music places another and compressed popular music another. Any setting of minimum audio quality criteria on the main program channel would be arbitrary. It would also be counter to the principle of maximizing spectrum efficiency. The bandwidth of the audio codec could be dynamically adjusted by the transmission system to make most efficient use of the channel at any given time. If not, at least a program-by-program adjustment could be made to optimize efficiency. For example, more bandwidth could be recovered when a voice segment occurs on the station than when certain music or voice-over-music occurs. With arbitrary bandwidth criteria placed on the main program audio, broadcasters' hands are tied unnecessarily.

The main reason that IBOC transmission is of high quality is the manner in which the digital transmission conquers the flaws of the radio channel between transmitter and receiver. All codec bandwidths benefit from this essential characteristic of IBOC. The selection of bandwidth for the audio is an almost continuously-variable choice (in increments reportedly as small as eight bits per second). Thus the selection of the audio codec bit rate should be left to the judgment of the programmer who is trying to attract an audience.

The only requirement should be that if IBOC is in use and there is programming on the analog channel, the main program audio should be transmitted in IBOC as well. Such a requirement is independent of the service, AM or FM.

Par. 20:

With the foregoing premise about enabling the broadcasters to tailor their main program audio bandwidth to the programming need, the remaining bandwidth is available for new services. To optimize spectrum efficiency, programming decisions about the bandwidth of the main program audio are a balance of the program type, the audience expectations, and the number of free channels of programming. (Also, the amount of program-associated data)

The diversity goals of the Commission can be met by enabling the transmission of multiple program channels. While the main channel is the only channel that blends from analog at acquisition and to analog in the event of digital failure, the supplemental programming is thus positioned to serve specialty needs. For instance, a reading service that is accessible by a simple button push after tuning a particular station with an inexpensive mass market receiver could benefit even more of those individuals with vision difficulties than the present subcarrier system does; and its universal accessibility via off-the-shelf consumer radios could benefit the entire medium of reading services in a way not foreseen. (Some copyright issues might have to be ironed out, but it would be unfortunate to drive reading services underground on a conditional access system if they might benefit from a more mainstream approach.)

Diversity could also conceivably be supported by a radio service for the hearing impaired. A transmission format for program texting (radio captioning) could be devised by enterprising innovators and standardized. "Click and Clack," Don Imus, Rush Limbaugh, local voice programs, and so many others could become accessible to the hearing impaired for the first time. With the potential for rich text and graphics, radio could become universally accessible. It is too soon to establish any regulations on this promising possibility and the industry should be given the time and the scope to develop such new features.

In terms of programming diversity, particularly to minority populations, whether they be ethnic, social, economic or other minorities, the availability of supplemental audio at the touch of a button on inexpensive consumer radios opens the field. In the Boston area, the Hatian community, among others, is being played to by a series of pirate radio stations that have vexed legitimate broadcasters for years. The potential audiences are dispersed geographically among various communities and it is a horribly inefficient use of spectrum to serve them in the present manner. Other specialty audiences are served legitimately via subcarrier transmissions, but this potential audience must employ hard-to-get receivers. If the specialty programming entrepreneurs could buy time on a supplemental audio program channel on an IBOC radio station, they could reach a larger audience and provide a broader public service, free to the target minority audience. Noncommercial stations could select specialty audiences that are underserved by the commercial market.

Par. 21 (also 39)

In response to the unaffiliated programmer question, the distinction of an unaffiliated programmer is a murky one. Today stations bring in continuous or program-specific programming produced by unaffiliated audio programmers. Satellite networks provide programming with local insertion capabilities that localize a program to better serve the local audience. Some stations perform “block programming” in which time is leased on the main channel for which each individual programmer must pay and provide content. Supplemental free-over-the-air programming on IBOC should remain the responsibility of the licensee, to the same degree current programming is. Supplementary channel services, program associated services, program independent services, block programming, network programming and whatever other innovations arise should be permitted so long as the licensee assumes responsibility for regulatory compliance and serving the public interest, particularly on any freely accessible content (as opposed to conditional access content).

Since the supplemental channel is secondary to the main program, in that it lacks the backup of blend from and to analog main audio, it is sensible to retain station identification of the host station for the supplemental channels and to place regulatory obligations on the licensee. Since there is no standard for supplemental audio transmission yet, it would be premature to establish naming conventions for supplemental audio programs. The industry standard should address this (while it might be as simple as the DTV identification WXYZ-1, WXYZ-2, and so on, it would be best to let the industry work out this feature to insure the most user-friendliness.)

Par.s 22 & 23:

The question of storecasting or other subscription services is asked. With the flexibility of digital transmission, one program stream can readily be "repurposed" as the multimedia people call it. The simplest example is the historical example of storecasting in which non-music programming is automatically blanked out of a special receiver in the subscriber's store. This becomes, in effect a separate program stream or format that deviates from the broadcast program in a couple of ways. Its experience is not free-over-the-air radio. The programmer would have to negotiate storecasting privileges with the owners of the rights to the music, just as other storecasters do. This would appear to require no regulatory change. The advertiser does not benefit from exposure on this repurposed audio stream, so it is in the broadcaster's interest to make a clear distinction about what audience the advertiser is buying access to. Audience survey companies will have to work out a way to be sure the two program streams are seen as different programs by the surveyed listener or the people meter. These are soluble problems based on sound and legal business practices that also require no intervention. Therefore, any program to which conditional access is granted falls under the category of a closed circuit service, which has an historical parallel in the subcarrier music and data services. No additional regulation need be applied.

Par. 24:

In the noncommercial realm, the present conditions on noncommercial broadcasters relating to reading services could be extended to supplemental audio services on IBOC. Obviously, any change in an existing service's mode of delivery, be it the station, the subcarrier, or the IBOC supplemental channel, requires a cooperative effort to ensure the beneficiaries of the service suffer no hardship.

Par.s: 26 & 27:

First generation IBOC text services are quite primitive, as the ID3 format is not engineered for the limited transmission bandwidth and limited display functionality of mobile radios. Future services will evolve, and they should be permitted without reservation to encourage innovation and competition. Industry standards should be the guide for preventing wholesale obsolescence of certain standardized receiver designs. Off-the-shelf receivers that employ non-standardized transmission protocols technologies should not be put up for sale to the public. The danger in letting the market sell radios that function under different protocols is in the potential dominance of a proprietary standard at the expense of competition, on the monopolistic end of the economic spectrum, and the potential balkanization of the marketplace like AM stereo, on the unfettered competition end of the spectrum.

For example, a group could develop a supplemental audio program service with proprietary features and make it a de facto standard by releasing it to the public before a standard is established. Other entrants, who may have valuable innovations to offer the supplemental audio field, could be locked out of the arena by such an action. Alternatively, a noncommercial broadcaster might develop one supplemental audio technology and a large commercial broadcasting enterprise might develop another technology, the two of which are incompatible. Consumers, then, would have to choose between two distinct types of radios, and the IBOC market becomes fractured and non-uniform.

For any free over-the-air service, sponsorship identification rules should apply. Because text and graphics, and possibly programs such as games, may become part of the transmission stream, it may be necessary to see how these technologies evolve before applying sponsorship rules that in hindsight might be too cumbersome.

Par. 29:

Spectrum fees and subscription services. The radio industry already has a precedent in the use of subcarrier services for a variety of purposes, such as free broadcast, user-subscribed, or privately leased services. The development of IBOC data services is an extension of this subsidiary communications philosophy. IBOC services will be based on a platform that is designed to evolve consumer-based applications so the advent of data services will largely follow the consumer, both for free and for fee. Private data services intended for very small receiver bases are likely to have far less growth and attraction than more universal, consumer-oriented applications. The listener's first attraction will be the station's flagship main program, and the various supplemental free and for-fee services will be related to the needs and interests of the audience member. As competition for listenership heats up with the satellite and recorded media, the drive to reduce advertising time and increase programming time to be competitive may also heat up. Being able to offer for-fee services and advertising supported services in parallel with the main program will enable broadcasters to improve the quality and competitiveness of their programming to the public. A tax on this activity will ensure the premature death of such an opportunity, because the new services are more about competitiveness, relevance, and better public service than they are about new profits. There are only so many person-hours per day available for radio listening and interaction. Because IBOC is an in-band technology, there is no windfall bandwidth the way DTV created a five-fold increase in standard definition capacity. The DTV bandwidth explosion set up a situation where the data applications could eclipse the main channel in value, becoming the data tail wagging the broadcast dog. This is not the case with IBOC.

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Par: 32

Since program audio codec rates are adjustable in very small increments, and since there is no "resolution" that corresponds to the television concept of "definition"— high, standard or otherwise— and since the codec rate should be tailored to the audio and the audience expectations, there is no reason to differentiate between program service qualities as there is with DTV. The concepts of high definition and standard definition audio are not realistic. The term, High Definition Audio may be the unfortunate result of the selection by iBiquity of the HD-Radio™ brand name because the initials HD are recognized by the consumer. The public interest is served by broadcasters trying to appeal to the widest possible audience(s) by efficiently managing their IBOC bandwidth to provide the highest and best use at any given moment. The only necessary requirement is to transmit an IBOC main program audio channel while the analog program is transmitting.

Par. 33:

With the advent of supplemental audio, which is not ready and is not yet standardized, broadcasters may find it useful to reschedule the special local programming they run during the typical graveyard times onto their supplemental channels where audiences can access them more readily. This type of use has to be given a chance to evolve to see how it is received by the public, so it would be premature to require particular public-interest use of the supplemental channel when it is adopted as a standard.

Par: 34:

To facilitate the highest and best use of the new medium, the licensee's local origination and public service requirements should be in the aggregate, not on a channel-by-channel basis.

Par. 37:

I addition to transmitting EAS content on each continuously running program channel when EAS is activated, the industry should adopt an EAS protocol for the data transport. We are not aware of any testing of the EAS audio data busts through the IBOC codec and transmission channel. The only reason to transmit this data on the digital audio program is because it will continue to be broadcast on the analog channel. Ultimately, the primitive data bursts on the audio should be replaced by an EAS transport scheme on IBOC.

Par. 47:

FM Definitions. The channel should be redefined by its center frequency, not the channel width, and by the two transmission standards: analog deviation and occupied bandwidth, and digital waveform and occupied bandwidth.

The question of how to evaluate compliant occupied bandwidth was the subject of a paper presented by David Maxson at the 2004 NAB Broadcast Engineering Conference. IBiquity has a tentative specification for measuring and confirming occupied bandwidth. This method requires more analysis for accuracy and repeatability and, for out of band emissions particularly on 4^{th} adjacent channel, more study regarding the impact of the proposed mask on existing reception. Minor interference from less-well-filtered transmitters can occur on 4^{th} adjacent channels in an area that is somewhat greater than the blanketing area in some cases.

Power level measurement should occur either directly by measurement off the transmission line(s) going to the antenna(s) of FM IBOC stations, or indirectly by sampling pre-combined output powers and having well-characterized combiner units. Power measurement of digital waveforms is tricky, and made trickier by the presence of the analog signal. New equipment is being developed to take measurements.

During the hybrid phase, the ratio between analog and digital energy is set by careful design and testing. As long as hybrid transmissions exist, the basic system of station assignment is the controlling factor. At some time in the distant future when most of the nearly one billion radios in circulation have been supplanted by IBOC radios, all-digital assignment criteria might be considered. Considering that the present separation rules and interference protection rules are based on a fairly coarse rubric that is not particularly representative of any given FM station's actual analog listening area, it could continue to be the rubric for all-digital assignments, or it could be the basis for a new all-digital rubric. Receivers have been and will be designed to the way in which stations are currently separated, so the separation rules should remain essentially unchanged.

Par. 55:

Translators that can receive the host analog signal over the air should be permitted to convey the host analog and IBOC signal via alternate means. The analog reception could be the backup to the alternate link. The commission could spot-check the translator compliance upon inspection by requesting that the remote link be disconnected and replaced with the backup analog signal to verify that it is entitled to the remote feed. Alternatively, a point-to-point path analysis resulting in a very low, but useable median signal strength, could be applied as the test for eligibility.

Par.s 56 & 57:

Patents and Standards. Reasonable and non-discriminatory licensing is one aspect of the process of open standards development. IBiquity has pledged to conduct its licensing affairs in such a manner. iBiquity should offer a la carte access to its core technologies in the IBOC standards to enable competitors to innovate competing products and features *in iBiquity's market space* that are compliant with the standard. The NRSC is close to completing a transmission standard for the main audio service and the digital waveform. The standard will ultimately include an open platform for data and supplemental audio transmission, but this will come later. Also, parties should be discouraged from offering

non-standardized production models of anything, including supplemental audio because of the risk of premature obsolescence and incompatibility with the final standard. Alternatively, non-standard devices placed prematurely on the market create pressure to accept the technology as a de-facto standard. There is the possibility that this will occur with the first proposed supplemental audio service technology. It is more difficult to force a de facto standard to be open and consensus based. Without open and consensus based standards in the auxiliary services, there is a risk of dominance of one player in the innovation and provision of these capabilities. Competition is the key to a robust digital broadcasting industry. The FCC should encourage all parties to continue to participate in continuing standardization of the many features that IBOC radio has yet to offer.

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